AFFTC-TIM-99-04

PUBLISHING A MULTIMEDIA TECHNICAL REPORT IN ELECTRONIC FORMAT

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FINAL REPORT

Approved for public release; distribution is unlimited.

AIR FORCE FLIGHT TEST CENTER
EDWARDS AIR FORCE BASE, CALIFORNIA
AIR FORCE MATERIEL COMMAND
UNITED STATES AIR FORCE

AFFTC

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This technical information memorandum describes the multimedia authoring procedures and lessons learned during the publication of AFFTC-TR-97-49, *Evaluation of the AN/AVS-8 (V) Night Vision System*, on compact disc-read-only memory (CD-ROM). This memorandum identifies potential benefits of electronic publication, the potential of multimedia to be an integral part of the data collection and analysis process, the specific procedures employed for CD-ROM development, and includes recommendations for future Air Force Flight Test Center publishing.

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PREFACE

This technical memorandum describes the multimedia authoring procedures and lessons learned during the publication of AFFTC-TR-97-49, *Evaluation of the AN/AVS-8 (V) Night Vision System*, on compact disc read-only memory (CD-ROM). This memorandum identifies potential benefits of electronic publication, the potential of multimedia to be an integral part of the data collection and analysis process, the specific procedures employed for CD-ROM development, and includes recommendations for future Air Force Flight Test Center publishing. In addition to this memorandum, the above-identified technical report on CD-ROM served as an example of multimedia publication.

Sincere appreciation is expressed to Annette Anderson (412 TW/TSFR) and Kurt Joseph (412TW/RMSP) for their many valuable technical contributions to this effort.

EXECUTIVE SUMMARY

In 1997, the Air Force Flight Test Center (AFFTC) conducted an evaluation of the new Night Vision System [AN/AVS-8 (V)] for the Human Systems Center (now the 311 Human Systems Test Wing at Brooks AFB, Texas). The results of this evaluation were sent to the customer in the form of a paper-based test and evaluation results sheet (TERS), AFFTC-TERS-97-17, in June 1998. After delivery of the TERS, the customer indicated that they would also like this report on compact disc-read-only memory (CD-ROM). The AFFTC developed a CD-ROM version of the TERS using Microsoft Word® for the text, hyperlinks to facilitate navigation within the document, and high-resolution picture files of the illustrations. Prior to this report publication on CD-ROM, all AFFTC reports were paper-based publications. The CD-ROM version was well received by the customer.

The 412 Test Wing, Airframe Systems Integration Division (TSS) decided to fund the development of the TERS into a multimedia technical report (TR). The objective of this project was to demonstrate multimedia methods for data collection and analysis and to develop an example multimedia technical report on CD-ROM with an accompanying hardcopy version. The electronic product needed to be in a format acceptable to the Defense Technical Information Center (DTIC) for electronic publishing. The electronic report was developed in Adobe Portable Document Format (PDF)®, extensive hyperlinks were used to facilitate navigation throughout the document. An interactive multimedia presentation was developed in IMSI Multimedia Fusion® as a self-running executable file. High-resolution picture files of the illustrations and multimedia frames were included for printing or detailed visual inspection.

The overall objective of demonstrating the application and worth of multimedia methods and electronic publication for testing and reporting was met. The developed TR was published on CD-ROM in a format that was acceptable to DTIC for electronic publishing. The multimedia technical report also was well received by the customer. Electronic publishing on CD-ROM, including multimedia, should be considered for future AFFTC technical publications.

Many lessons were learned during this effort, and these lessons are included as an appendix to this technical memorandum. Multimedia should be considered during the initial test-planning phase to ensure success with data collection, data analysis, and results publication. No single approach considered for text and multimedia authoring met all requirements, and compromises were inherent in each approach selected. The PDF format should be considered for electronic publishing of text files because the Acrobat viewer facilitated navigation through the document and retained the original format for viewing as well as printing. The use of self-running multimedia files should be used because self-running files did not require installation on the user's computer, and multimedia display was not dependent upon the specific browser or browser settings on the user's computer.

TABLE OF CONTENTS

Page No.

PREFACE iii

EXECUTIVE SUMMARY iv

LIST OF ILLUSTRATIONS vi

LIST OF TABLES vi

INTRODUCTION 1
- Background 1
- Project Objectives 1
- Electronic Publishing 2
- Multimedia 3

PROJECT ELEMENTS 4
- Initial Project Plan and Problems Encountered 4
  - Initial Plan 4
  - Problems Encountered 5
- Actual Project Execution 5
  - Authoring Tools Considered 7
  - Multimedia Authoring 10
  - Product Verification 13
  - Technical Report Verification 14
  - Technical Report Application 15

CONCLUSIONS AND RECOMMENDATIONS 17

REFERENCES 18

APPENDIX A - REQUIREMENTS FOR EDWARDS STORE SEPARATION ANALYSIS SYSTEM DATA ANALYSIS 19

APPENDIX B - LESSONS LEARNED SUMMARY 21

APPENDIX C - HARDWARE AND SOFTWARE USED 24

APPENDIX D - ADOBE ACROBAT VERSION 3.01 SETTINGS USED 26

APPENDIX E - GENERIC MULTIMEDIA PUBLICATION GUIDANCE 28

APPENDIX F - BETA TESTING SURVEY 36

LIST OF ABBREVIATIONS AND ACRONYMS 39

LIST OF ILLUSTRATIONS

Figure		Page No.
1	Initial Project Plan	4
2	Actual Project Execution	6
3	Flowchart Used for Multimedia Product	11

APPENDIX E

E1	Generic Pretest and Test Activities	29
E2	Generic Plan for Developing Multimedia Reports	30

LIST OF TABLES

Table		Page No.
1	Differences Between Publishing Approaches	2
2	Text Authoring Tools Considered	7
3	Multimedia Authoring Tools Considered	9
4	Project Objectives and Attainment	15

INTRODUCTION

BACKGROUND

In 1997, the Air Force Flight Test Center (AFFTC) conducted an evaluation of a night vision system for the Human Systems Center. This new night vision system (NVS) could automatically separate the night vision goggles (NVGs) from the user's helmet at the start of an ejection sequence. The results of this report were sent to the customer in the form of a paper-based test and evaluation results sheet (TERS), AFFTC-TERS-97-17, in January 1998 (Reference 1). After delivery of the TERS, the customer requested a copy of the report on compact disc-read-only memory (CD-ROM). The AFFTC developed a CD-ROM version of the TERS using Microsoft Word® for the text, and which included hyperlinks to facilitate navigation within the document and high-resolution picture files of the illustrations. The CD-ROM version of the TERS was delivered in June 1998, and was well received by the customer.

Prior to the delivery of the TERS on CD-ROM, technical reports at the AFFTC had been published as bound hardcopy. The AFFTC author's guide addresses technical reports primarily as paper-based documents (Reference 2). Paper-based publishing had a history of reader acceptance but had disadvantages compared with electronic publishing, that is, publishing on computer media. To demonstrate the potential of electronic publication, the 412 Test Wing, Airframe Systems Integration Division (TSS) decided to fund the development of the content of the TERS as a multimedia technical report (TR) to be published on CD-ROM. Although the entire report could have been developed as a single multimedia presentation, the project was developed as two distinct parts, a text report and supporting multimedia presentation, published on CD-ROM.

PROJECT OBJECTIVES

The overall objective of this project is to demonstrate the application and value of multimedia methods and electronic publication for testing and reporting. Specific project objectives are:

1. To employ multimedia as part of the analytic process to support assessment of test objectives, conclusions, and recommendations,

2. To exercise multimedia procedures that would support:

    a. Frame-by-frame (shuttered) video presentations,

    b. Determination of time-space positioning information (TSPI), and

    c. Synchronized display of data plots and movie frames,

3. To provide zoom-in display capability for the user,

4. To determine a report format that would be compatible with a majority of user computers with a minimum of requirements,

5. To determine a report format that would meet requirements of the Defense Technical Information Center (DTIC), and

6. To produce a final product that is durable and sustainable over time.

ELECTRONIC PUBLISHING

A comparison of paper and electronic publication methods is presented in Table 1. Writing styles and techniques may be adopted to maximize the new capabilities of electronic publication (References 3, 4, 5 and 6). An extremely powerful new authoring capability for electronic publication was the hyperlink. Authors could 'hot spot' individual words or pictures so that mouse clicks on these 'hot spots' would transfer (hyperlink) the reader instantly to different sections within the document or anywhere in the world via the World Wide Web (WWW). Another electronic publication capability was the 'mouse-over,' or movement of the cursor over an object or word usually achieved by mouse movement. A mouse-over could make words or pictures change in some way when the cursor was moved over them. For example, a mouse-over could turn a word red, and a mouse click on this red word could cause some additional action, such as a narration, a movie presentation, or hyperlink to additional text. Another electronic publication capability was to make the table of contents available as 'thumbnails' (tiny pictures of each document page). Additionally, it was possible to add features into multimedia documents, such as animations, moving or flashing words, and fancy transitions from one frame to the next. However, these techniques should be used to support communication of the message and should not be used where they might detract from the message itself.

Table 1
DIFFERENCES BETWEEN PUBLISHING APPROACHES

Paper-based Documents	
Pros	Cons
Long tradition of successful use and acceptance.	Expensive to produce, ship, and bulky to store.
No support equipment required for viewing.	To copy document, disassembly could be required and image quality degraded with each generation.
Can be published with archival quality materials.	Color was an extra publishing and copying expense.
Portable.	Cannot convert to electronic form easily as optical character recognition was difficult and error prone.
Electronic Documents	
Pros	Cons
Permits user control and interactivity. User can select instantly what to read, see, or hear. User can select presentation format.	User must have computer supporting multimedia to experience full capability of document.
Hyperlinks could jump within and between documents, including documents on the World Wide Web (making documents unbounded).	Current typical desktop computers may not be adequate for electronic documents.
Full color, movies, sound and animations can be included without additional publishing cost.	Potential obsolescence of required computer playback software and hardware.
An entire report could be put on one compact disc.	Some paper-based copies may still be needed.

MULTIMEDIA

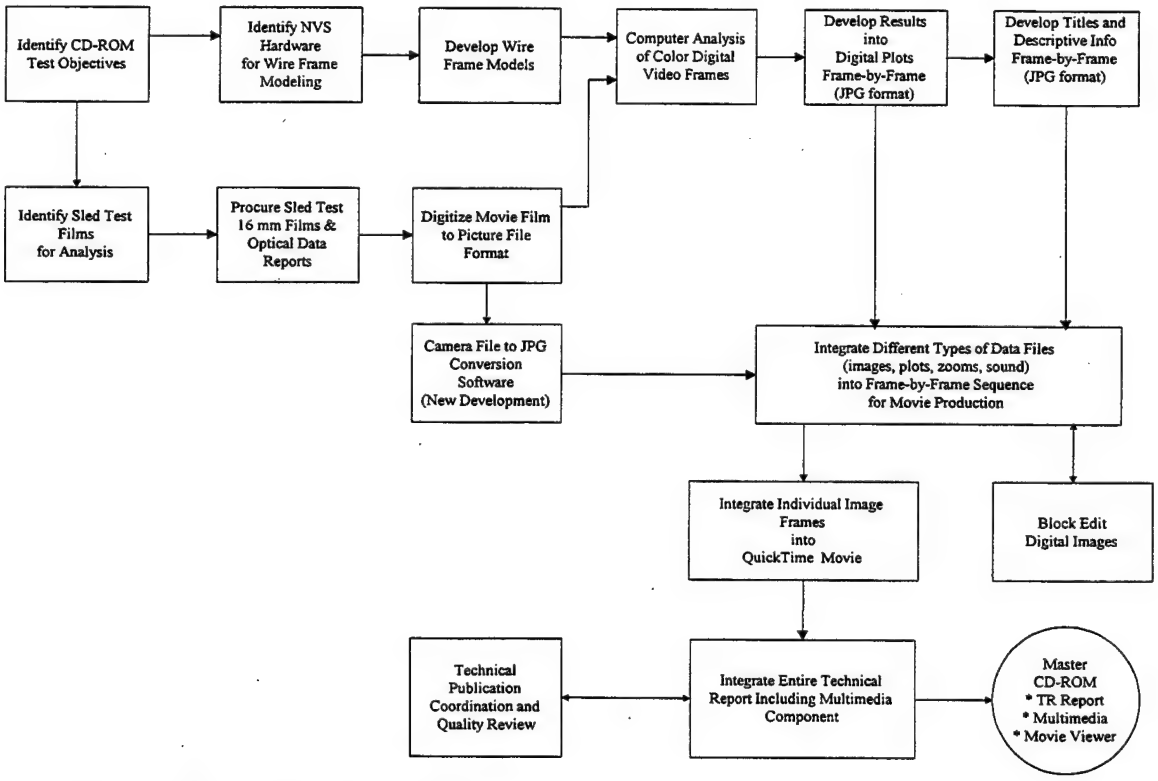
Multimedia was defined as a single presentation that included several mediums of communication, such as text documents, movies, light shows, still slides, and narration. Media that were considered for this project had to be publishable on CD-ROM. Multimedia offered additional potential as an instrument for data collection, data analysis, and the presentation of results. By employing computer-assisted modeling and simulation, multimedia methods could provide test engineers with clearer pictures of test events. The same media products collected during testing and simulation studies could be carried over to the final report, thus adding minimal burden or time for report publication. Additionally, multimedia could offer improved communication for technical issues and test results. Multimedia presentations could be authored to permit interaction between the user and the presentation media, such as the topics to read, the movies and animated sequences to see, the narration to hear, and the sequence of report presentation. User involvement through multimedia interaction has been known to increase motivation and learning (Reference 7). Furthermore, multimedia documents could be structured from a 'top-down' perspective, so that the reader could focus on top-level issues and then go into greater detail (analysis). Conversely, the reader could start with specific details and work from the details to the major findings (synthesis).

PROJECT ELEMENTS

INITIAL PROJECT PLAN AND PROBLEMS ENCOUNTERED

Initial Plan:

The initial plan for the expected multimedia project is shown in Figure 1. Multimedia was to be employed as part of the analytic process to assess specific test objectives. To meet project objectives, this plan relied heavily on movie film digitization and data analyses from the Range (412 TW/TSR). The Range had a capability called the Edwards Store Separation Analysis System (ESSAS) which could support modeling and simulation studies of events captured on 16-mm motion picture film. The initial project plan called for the ESSAS group to use the 16-mm sled test movie film in conjunction with wire frame models of night vision system (NVS) hardware to compute TSPI measurements, such as NVG goggle rotation, goggle-head miss-distance, and goggle trajectory. Data plots would be time-synchronized to associated movie files on a frame by frame basis. Capability was to be provided to permit users to zoom into areas of special interest. Sounds and narration were to be used to clarify events of interest.



Notes: 1. NVS - night vision system
2. CD-ROM - compact disk-read-only memory

Figure 1 Initial Project Plan

Problems Encountered:

The High-speed Test Track at Holloman AFB, New Mexico was requested to provide still photographs and high-speed motion pictures of the NVS test for visual analysis. Topics of concern for the NVS test were the operation of the automatic goggle release system, the trajectory of the goggles upon release, differences between aircraft types, and differences between single seat and tandem seat aircraft. The Test Track was not requested to provide data suitable for ESSAS analyses, which would have included triangulated camera positions, precise camera positioning, and calibration of the photo-optical systems. Consequently, the data collected during the NVS test were inadequate to support ESSAS analyses or to demonstrate multimedia as part of the analytic processes. **If Edwards Store Separation Analysis System (ESSAS) analysis is planned, ESSAS requirements should be considered during the test-planning phase. (LL1)**[1] The ESSAS data requirements are presented in Reference 8 and Appendix A. The lessons learned throughout this project are documented in Appendix B. Because the data collected during the NVS test were inadequate to support ESSAS analyses, this project was unable to demonstrate multimedia as part of the analytic processes. The data collected during the NVS test were inadequate to support ESSAS analyses because multimedia data analysis had not been identified in the initial project plan. **Multimedia should be considered during the initial test-planning phase to ensure success with data collection, data analysis, and results publication. (R1)**[2]

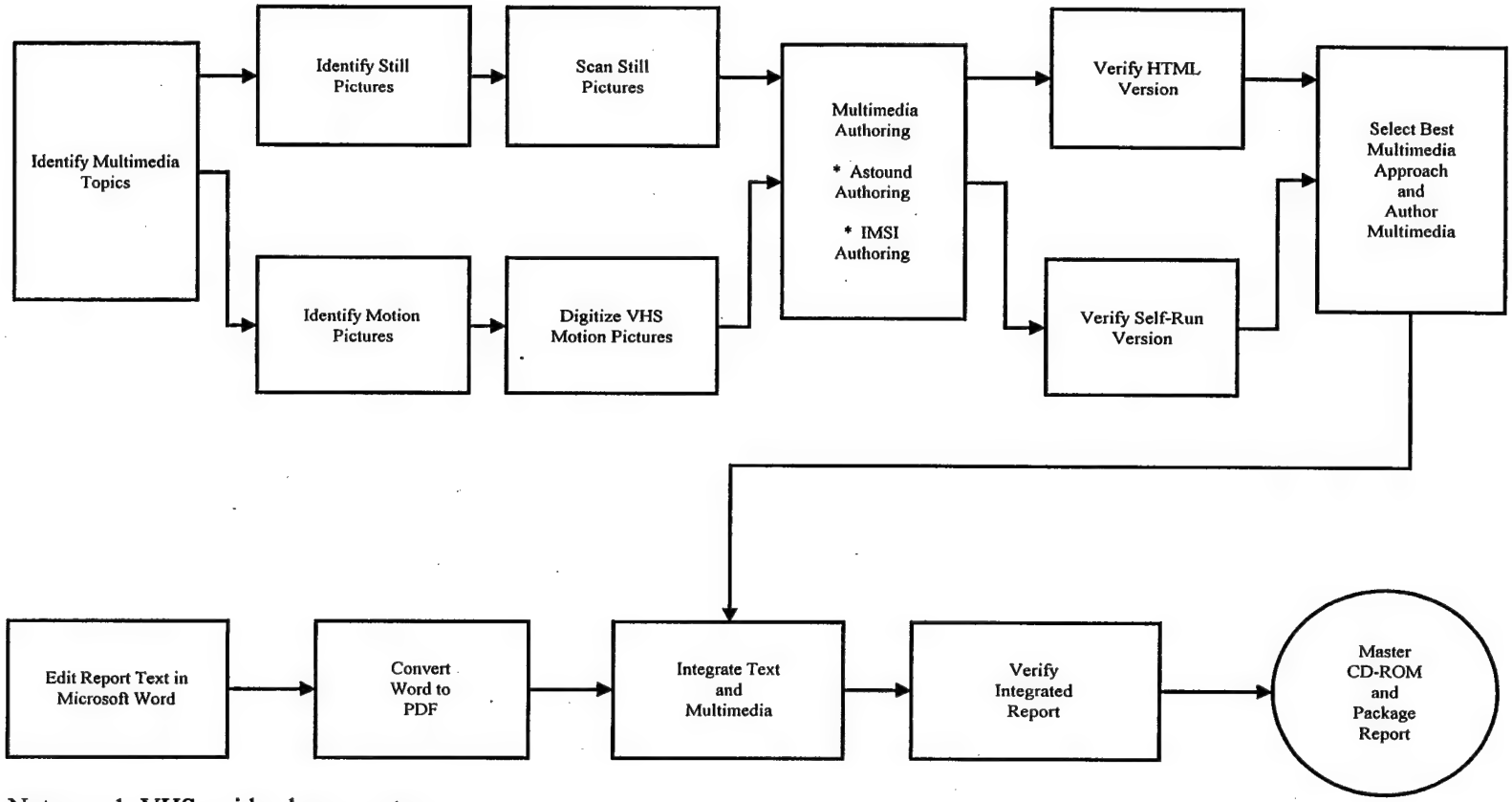
Initially, the ESSAS group was to digitize selected NVS test motion picture films for conversion into high-resolution (640 X 480 pixels) digital movie files. However, the ESSAS group's camera was not color capable and the digital output file was non-standard in format. Therefore, the ESSAS group could not perform the film digitization as identified in the initial project plan (Reference 9). Additionally, the project could not achieve the following objectives: obtaining shuttered video for the multimedia, determination of TSPI information, and the synchronization of data plots and movie frames. The Range was in the process of upgrading their system with a color digital camera having a standard file format. **The upgraded ESSAS capability should be considered as a resource to support multimedia data collection, film digitization, and data analysis. (LL2)**

ACTUAL PROJECT EXECUTION

Figure 2 shows the actual project plan, which was used for editing, authoring, and publishing the technical report on CD-ROM. The hardware and software used for this project are identified in Appendix C. Since multimedia techniques were not used to assess test objectives, a decision was made to build the multimedia presentation upon the NVS sled test runs.

[1] Numerals preceded by an LL within parentheses at the end of a sentence correspond to the lessons learned tabulated in Appendix B of this technical memorandum.

[2] Numerals preceded by an R within parentheses at the end of a sentence correspond to the recommendations tabulated in the Conclusions and Recommendations section of this memorandum.



Notes: 1. VHS - video home system
2. HTML - hypertext markup language
3. PDF - portable document format
4. CD-ROM - compact disc-read-only memory

Figure 2 Actual Project Execution

Authoring Tools Considered:

Table 2 identifies alternatives for text authoring and formatting for publication. No single approach met all text and multimedia authoring requirements, and the approaches selected involved compromises. Requirements for DTIC electronic publications are identified in Reference 10. Approaches were evaluated on how well they met the following criteria:

a. Acceptable to DTIC,

b. Usable on most multimedia computers,

c. Moderate hardware requirements for user computer,

d. Minimum requirements to install software on user computer,

e. Intuitive and easy to use, and

f. Capable of printing document without altering format or pagination.

Table 2
TEXT AUTHORING TOOLS CONSIDERED

Authoring Tool	Pros	Cons
Microsoft Word®	Format retained when copied and pasted into Word documents.	User computer was required to have Microsoft Word. Navigation throughout document was difficult. Display or printed output may be altered when using different printer drivers.
Standard Generalized Markup Language (SGML)	At one time, SGML was a DoD standard for cross-platform publication.	In practice, SGML was never implemented by DoD. Infrequently used and costly. Not recommended by Defense Technical Information Center.
Static Hypertext Mark-up Language (HTML)	Most web browsers supported static HTML.	Navigation navigate through document was difficult. Display was browser dependent.
Adobe Portable Document Format (PDF)®	Free viewer, already installed on most computers. Navigation within and between files was supported. Very convenient and easy to use. Format and pagination remained invariant for display and printing.	Formatting lost when copying and pasting into Microsoft Word.

Since AFFTC TRs were distributed to DTIC, the electronic publishing approaches selected must meet DTIC requirements. Several computer document formats were considered for electronic publication. The standard generalized mark-up language (SGML) was specified as a DoD standard for cross-platform publication, but SGML was never implemented, the software authoring programs were expensive, and the overall approach was not recommended by DTIC. Another possibility was static HTML, but it suffered in terms of being browser-dependent, providing poor navigation throughout the document, and loosing formatting when printed. Microsoft Word was considered, but Word was not well suited for computer display since the printer driver selected on the user's computer could alter the visual display format, printing format, and pagination. The Adobe PDF Version 3.01 was considered. Microsoft Word, HTML, and Adobe PDF formats were acceptable to DTIC for electronic publishing. **No single approach considered for text and multimedia authoring met all requirements, and compromises were inherent in each approach selected. (LL3)** The Adobe PDF format was selected as the most desirable format for electronic publication because it retained both display and printing format and because the viewer included additional features to facilitate document browsing on the user's computer. This approach did require that an Adobe Acrobat Viewer was installed on the user's computer, but the viewer was freely distributed and in widespread use.

High-resolution picture files were usually used in documents intended for printing because they provided superior printing quality. However, high-resolution picture files provided annoyingly slow computer display while low-resolution picture files could provide faster and more satisfactory computer display. High-resolution picture files could be used for detailed visual examination, projection during group meetings, photo editing, quality printouts, or for incorporation into other documents. **Low-resolution picture files should be used within documents to provide rapid display and high-resolution copies of these pictures provided on the compact disc-read-only memory for printing, high-quality display, or other uses. (LL4)**

Publishing for electronic media was not the same as publishing on paper. Conventional paper-based documents used blank pages so that a major topic always started on the right side of a center-folded document. This approach was logical and helpful for the reader. **Blank pages should not be incorporated into electronic publications because they are annoying for the reader. (LL5)** Presented with a blank page, the computer user had to scroll down or up with the mouse or keyboard to find meaningful document material. Therefore blank pages were eliminated from the documents intended for computer display. Dual column format was used for printed documents to facilitate reading. Dual column format required less horizontal eye movement per line. **Single column format should be used for electronic publications because dual column format required twice as much mouse or keyboard scrolling, which was annoying for the reader. (LL6)** Therefore, single column document format was selected for documents intended for the electronic publication.

Only minor text touch-up was available within Acrobat Exchange for editing the PDF files. Editing in Acrobat Exchange was restricted to editing words on a single line, as word wrapping was not possible. **All text editing (except for inserting or revising hyperlinks) should be done in the Microsoft Word files before conversion into PDF files. (LL7)**

Minimal effort was required to convert Microsoft Word files to Adobe PDF. The conversion of Word files to PDF files was accomplished using a suite of Adobe Acrobat Version 3.01 programs, including the Acrobat PDF Writer, Acrobat Distiller, and Acrobat Exchange in conjunction with a PostScript® printer driver (a QMS Magicolor Plus Level 2 driver was used for this project). Acrobat Version 3.01 was difficult to setup, and therefore the important settings used for PDF file development during this project were provided in Appendix D. Adobe Acrobat Version 4.0 was found to be much easier to install and set-up than Version 3.01. **Adobe Acrobat Version 4.0 or later**

should be used for creating PDF files from document files. (LL8) The Adobe programs were initiated in an automated sequence from within Microsoft Word by using the 'Create Adobe PDF' command from the file menu. During the early stages of this project, the hyperlinks within the Word document were changed to reference the anticipated Adobe PDF files. However, the Adobe PDF Writer Version 3.01 did not carry over linking to bookmarks thus requiring additional editing using Acrobat Exchange. **Hyperlinks should be established in the Adobe PDF files as they are configured for publication to reduce redundancy of verification efforts. (LL9)** Initially, hyperlinks were set to the start of a text file, but this was inconvenient for the reader. However, hyperlinks could be set to a file and then to bookmarks within the file for precise location. **Hyperlinks should take the reader to the exact position desired within a document, rather than to the start of a file. (LL10)** Documents for electronic publication should be organized in the folder and file arrangements to be recorded on the CD-ROM. **Trial compact discs should be recorded and tested on different computers to ensure that hyperlinks were not made to unintended files residing in other locations on the authoring computer. (LL11)**

Because electronic publications including multimedia were new to the AFFTC, many desktop computer systems were not set-up adequately to support multimedia. **As a prerequisite for successful electronic publication, all user computers should be configured to support multimedia. (LL12)** Several alternative formats were considered for authoring multimedia, and these formats are shown in Table 3. The SGML format was not selected because it was not implemented by DoD and was not recommended by DTIC. The HTML format was also considered, but the display of HTML documents depended heavily upon the web browser that was installed on the user's computer. **Individual computer setups were found to vary considerably in terms of browser selection, browser plug-ins, video cards, and display settings, all of which affected performance. (LL13)**

Table 3
MULTIMEDIA AUTHORING TOOLS CONSIDERED

Authoring Tool	Pros	Cons
Standard Generalized Markup Language (SGML)	At one time, SGML was a DoD standard for cross-platform publication.	Not implemented by DoD. Infrequently used and costly. Not recommended by DTIC[1].
Static Hypertest Markup Language (HTML)	Works with almost all web browsers.	Limited capability.
Dynamic HTML	Many display options were available.	Results varied on different computers. Browser dependent. Astound HTML failed validation test.
Astound® executable file	Easy, intuitive to author. No software had to be installed on user computer.	Some sound files within the self-run product were dropped through software glitch.
IMSI Multimedia Fusion® executable file	Highly capable and versatile program. Fast, stable output product. User was not required to install anything on computer.	Selecting from a wide variety of options made authoring time consuming. Could not copy and paste information from self-running program.

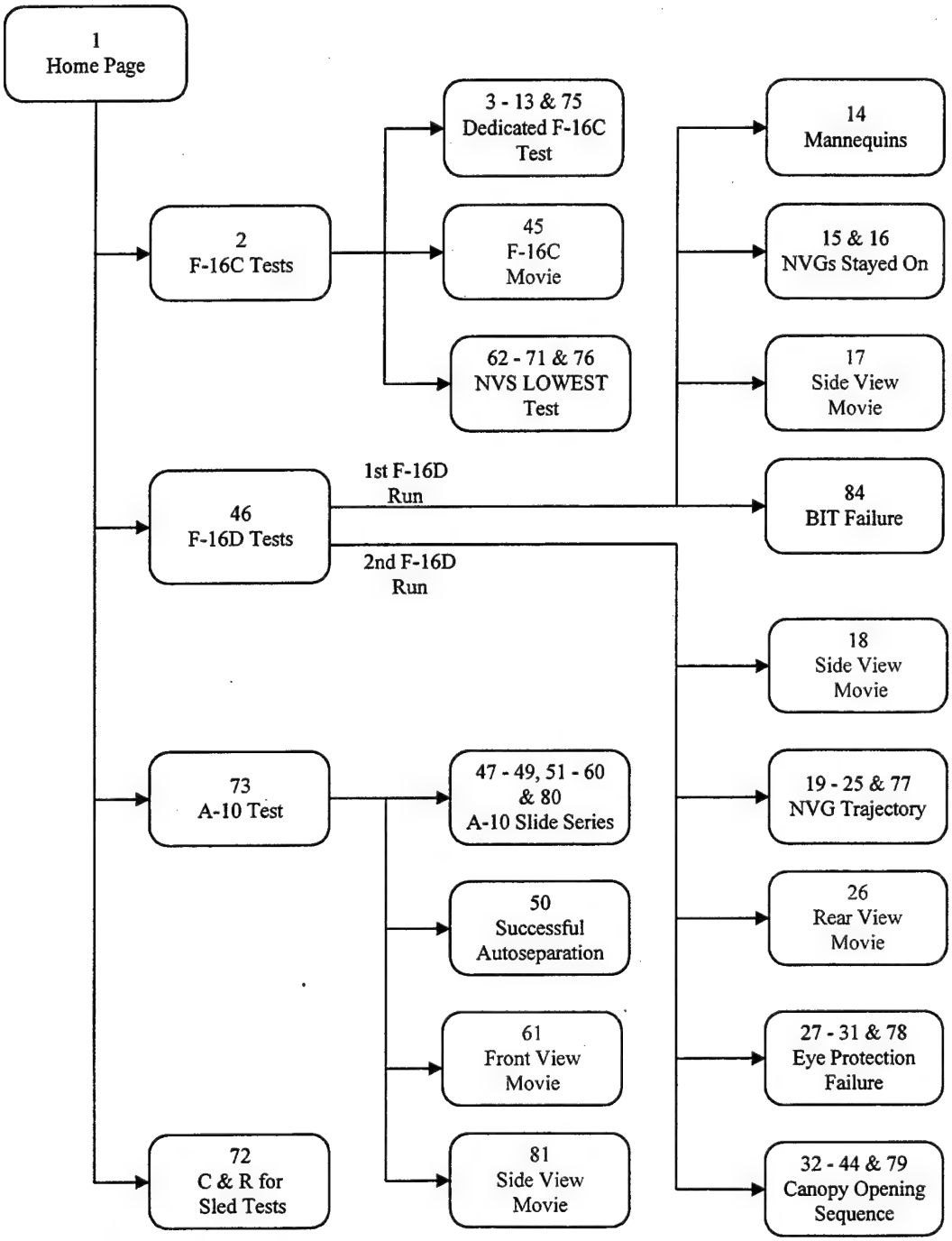
[1]Defense Technical Information Center

An authoring program called Astound® was suggested by an outside multimedia expert. The Astound program was easy to program and could produce document outputs as static HTML, dynamic HTML, or as self-running files. However, when producing executable self-running programs, Astound occasionally dropped some sound files. Concern with the Astound program dropping sound files led to the investigation of a program called IMSI Multimedia Fusion®. No single authoring approach considered for text and multimedia authoring met all requirements, and compromises were inherent in each approach selected. IMSI Multimedia Fusion was selected as the best of the alternatives tested for multimedia publishing because it was capable as an authoring tool and produced a solid, useful product that ran on almost all the computers tested. The only problems that occurred when using the Multimedia Fusion product were with the lack of suitable Motion Picture Experts Group (MPEG) movie viewers on the user's computer.

Multimedia Authoring:

Reference 7 provides an excellent discussion of multimedia production processes. Multimedia was developed on a frame-by-frame basis. Frame sizes for computer display were specified in pixels. Common computer display formats included: 640 X 480 pixels, 800 X 600 pixels, and 1024 X 768 pixels. Note that these formats all had a 4:3 aspect ratio, and that consistency of aspect ratio was desirable for esthetic reasons. An image size of 800 X 600 pixels was selected for the multimedia product because all multimedia computers could support this format and the picture quality was satisfactory. This frame size required a seventeen-inch (or larger) color monitor for best display.

The multimedia presentation was conceptualized in storyboard fashion, similarly to the approach used for developing animations and movies. The multimedia design focused on providing report content; in this case the results of the NVS sled test. The presentation was developed as a series of discrete frames and these frames organized in terms of logical flow. Figure 3 shows the structure of the multimedia product. The presentation started with a title or home page, shown in this figure as frame one. The home page presented the reader with the overall scope and topics that were included. The home page had links to take the reader to any of the major document sections. The major sections were designed to be relatively complete within themselves, like chapters in a book. Within each section, links were provided so that the reader could always return to the home page. Links to the home page prevented the reader from ending up in dead-end branches with nowhere to turn. Each major section consisted of one or more frames.



Notes: 1. NVGs - night vision goggles
2. BIT - built-in test
3. Numbers in each block are frame (page) numbers, where some blocks contain more than one frame
4. NVS - night vision system

Figure 3 Flowchart Used for Multimedia Product

During the initial concept development phase of authoring, each multimedia frame was conceptualized using a paper-based drawing that identified the content to be included. Content could include background images or colors, text fields, user interface buttons and controls, timelines, movies, animations, charts and figures, sounds, narration, and transitions from one frame to the next. Sequences of still photographs from the sled tests were scanned (digitized) with a flat bed scanner and saved as high-resolution picture files. These high-resolution picture files were then rescaled to provide both high and low-resolution files of each frame for multimedia authoring and publication. A detailed inventory of multimedia components was developed, including file names, file types, file sizes, and the date of revision. Opportunities for user interaction that support communication of the report content or message were identified. A prototype of the multimedia presentation was then developed, including all the intended frames, at least in skeletal form. The frames were then completed bit by bit. Backgrounds were added, text boxes added, and other elements were added. Links between frames were established and checked out. Multimedia development was an iterative process, consequently, the presentation was developed, tested, refined, and retested until satisfactory.

Movie films of the NVS sled runs were reviewed, and specific sections of these films were selected for digitization. The AFFTC photo lab was investigated as a source to digitize the 16-mm motion picture films. The photo lab had little experience digitizing motion picture film, and obtained assistance from the graphics lab. The photo lab in conjunction with the graphics lab used an Elmo TRV-16G to obtain digital images from the film, which were then rendered into QuickTime® movies by means of an authoring program (Macromedia Director®). However, the QuickTime® movie files developed by the photo lab and graphics lab were too low in resolution (160 X 120 pixels) to be satisfactory. The Human Factors Branch (TSFH) used videotape copies of the 16 mm film and a SNAZZI® video capture card to produce Motion Picture Experts Group (MPEG) movie files in a higher resolution (352 X 240 pixels) that provided a more satisfactory display. These MPEG movies, however, did not meet the project objective for developing shuttered video. The real need for this effort was to make high-resolution (640 X 480 pixels) movie files on a frame by frame basis. **Edwards AFB needs to have the capability to digitize 16-mm movie film on a frame by frame basis and to convert the resulting images into high-resolution movie files. (LL14)**

In general, people are quite intolerant of poor sound quality in multimedia presentations (Reference 7). This finding would suggest that specialized sound rooms were desirable for recording narration. However, a commercial sound room was not available, and the recordings were done during periods when there was minimal distraction. Narration files were developed using a Labtec C-324 noise-canceling headset with boom microphone in conjunction with the sound recording capabilities of Microsoft Windows 98. Narration was saved as .wav (sound file format) files, and was edited with an editing program packaged with a Diamond Multimedia Sonic Impact S90 sound card. **Monophonic sound recordings were found to be satisfactory for narration. (LL15)**

An authoring program called IMSI Multimedia Fusion (Reference 11) was selected as the most desirable of the alternatives tested for publishing the interactive multimedia component. Multimedia Fusion produced a product with rapid screen displays, good user interactivity, and reliable functioning on the computers tested. However, a file called CNCS232.dll had to be added in the multimedia folder on the CD-ROM. The multimedia product then ran without requiring software installation, thus meeting that specific project objective. **All software needed for display of the multimedia presentation, including DLL files, should be included on the published CD-ROM. (LL16)** However, authoring of

IMSI Multimedia Fusion was time-consuming, especially for a novice author, because of the many functions and options. Although many Multimedia Fusion features were used, there remained many potentially useful programming features that were not used during this project. For example, no use was made of animations, synchronized narration and animation, synchronized movies and narration, or hyperlinks to the World Wide Web.

Product Verification:

Verification of multimedia products for electronic publication was especially important because multimedia products contained numerous hyperlinks, different types of multimedia files, and because the products would be displayed on a wide variety of computers each having different hardware, different software, different capabilities, and different settings. **Verification testing, often called 'beta testing', should be performed on all multimedia products intended for publication. (LL17)** Appendix F contains a survey worksheet that may be used in support of beta testing. **An HTML validation test should be performed on all HTML documents that are intended for publication** (References 12, 13, and 14). **(LL18)**

The use of PDF files with the Acrobat reader for viewing text documents was demonstrated as a good choice, producing an excellent and user-friendly publication product acceptable to DTIC. The PDF was designed for electronic document publication and computer viewing rather than for word processing. An Adobe Acrobat viewer had to be installed on the user computer, but this viewer provided fast and convenient navigation within documents, navigation across files, and capability to zoom the display to different levels of magnification. The user could select to use bookmarks within the document for navigation, or could select to use tiny thumbnails of each page for navigation. The user could navigate by mouse or by keyboard commands. Altogether, the Acrobat reader provided rapid and satisfying methods for navigating text documents and accessing the multimedia presentation when published on computer media (CD-ROM). A negative feature of Adobe PDF files was that formatting was lost when copying from PDF files and pasting into Microsoft Word documents.

Static and dynamic HTML products were evaluated with a variety of Web browsers, including Microsoft Internet Explorer®, Netscape Navigator®, and the Opera® web browser (http://www.operasoftware.com/). These tests revealed that each browser had different versions, display and operating characteristics, plug-ins, and settings on user's computers. The Microsoft Internet Explorer browser proved to have the least difficulties displaying dynamic HTML documents. Browser difficulties were compounded with various authoring programs implementations of static and dynamic HTML. Furthermore, the Astound authoring program Version 5.0 produced HTML coding that did not pass HTML standards validation (References 5, 12, and 13), indicating that Astound HTML products might not perform correctly on some Web browsers. The Astound Version 5 also had problems producing self-run product files, which may be corrected in future revisions. Astound Versions 6.0 and later deserve a second look, especially for the executable file product. **The latest versions of all software considered for use should be evaluated for meaningful performance improvements. (LL19)** Multimedia Fusion was tested and was found to be a powerful, capable, and bug-free program that produced a self-running product that ran on all computers tested which had a suitable MPEG movie viewer.

Technical Report Verification:

The multimedia CD-ROM development project was accomplished in a number of steps:

1. The results of the NVS test were prepared as a paper-based TERS document (Reference 1),

2. The TERS in Microsoft Word was developed as a CD-ROM publication, using extensive hyperlinks and including high-resolution picture files for detailed viewing or subsequent use,

3. The TERS was developed into TR format as a paper-based document,

4. The TR document was converted from Microsoft Word to Adobe PDF files,

5. The multimedia was developed as a self-running interactive multimedia file using IMSI Multimedia Fusion as the authoring program,

6. The text documents and multimedia presentations were supplemented with high-resolution picture files,

7. All files in the configuration for electronic publication were put on the computer having the CD recorder,

8. Once in publication configuration, all document links were checked (LL21 and LL22), and

9. The TR was published on CD-ROM (Reference 15).

The CD-ROM mastering was accomplished using Adaptec Easy CD Creator Standard Edition® software in conjunction with a Smart and Friendly® CD-R4012. When the Adaptec CD mastering program was started, a title for the CD was added, the recording option of 'Data CD' was selected, the files selected to record, and the CD creation process started. The mastering program performed a test and recorded the CD without further intervention. The mastering process took about one-half hour at 4X recording speed. **High-quality blank CD-ROM media should be selected to ensure media longevity as well as playback compatibility with different CD drives and computer systems. (LL20)** Blank CD media differed in the types of dyes used as well as the physical structure of the CD including scratch-resistant coating. The phthalocyanine dye used in Ricoh Platinum® CD media claimed virtually 100% hardware compatibility and an expected life of over 200 years.

Viewing the PDF text documents required that the user's computers have Adobe Acrobat Reader installed. Most computer users had this program installed, but for those who did not, this program was provided on the CD-ROM. All software needed for display of the multimedia presentation, including DLL files, should be included on the published CD-ROM. Playback capability for MPEG movies was required of the user's computer. For computers without MPEG movie playback capability, the 'ReadMe' file referenced a software decoder that could be downloaded and installed by the user (www.visiblelight.com/mall/onstage/index.htp). **A 'ReadMe.txt' file on the CD-ROM should specify user requirements for computer hardware and software. (LL21)**

The CD-ROM itself should be labeled with the title, TR number, distribution statement, security classification, publisher, and report sign-off date. **Archival-quality CD-ROM labels should be used to hold up under years of expected usage. (LL22) The published CD label should be included on the CD-ROM in printable format, such as Adobe PDF, to support disc copy for duplication or replacement. (LL23)** The electronic publication included front and back paper covers with a few pages of descriptive material along with the CD-ROM in a plastic sleeve. The electronic publication product looked like a very thin conventional paper-based report. When desired, destruction of CD-ROMs was accomplished by cutting them into several pieces before trashing.

Technical Report Application:

Table 4 summarizes meeting of project objectives. The overall objective of demonstrating the application and worth of multimedia methods and electronic publication for testing and reporting was met. The electronically published technical report, including multimedia, was well received by the customer. **Electronic publishing on CD-ROM, including interactive multimedia, should be considered for future Air Force Flight Test Center technical publications. (R2)** The project objective of using multimedia for data collection and analysis was not met because of inadequate test data. The inadequate data collected during the NVS test resulted from the fact that proper data collection requirements were not specified during the test-planning phase. Data analysis with this inadequate data was attempted *ex post facto* without success. Many lessons were learned to guide future efforts, and lessons learned information is presented in Appendices A and B.

Table 4
PROJECT OBJECTIVES AND ATTAINMENT

Project Objectives	Objective Met
Overall applicability of electronic publishing for technical reporting.	Yes, electronic product was well received.
1. Multimedia as part of analytic process.	No, necessary test planning not performed.
2. Multimedia procedures to support: Frame-by-frame (shuttered) video, Time-space positioning information, and Synchronized plots and movies.	No, ESSAS camera system not suitable. No, Test data not planned for this analysis. No, TSPI analysis not performed.
3. Zoom-in visual display capability.	Yes, PDF viewer has zoom feature.
4. Work with wide variety of user computers.	Yes, PDF and MPEG viewers required.
5. Product acceptable to Defense Technical Information Center.	Yes, for both PDF and multimedia files.
6. Product durable and sustainable over time.	Yes, CD durable and PDF viewer was included.

Notes: 1. ESSAS – Edwards Stores Separation Analysis System
2. TSPI – time-space positioning information
3. PDF – portable document format
4. MPEG – Motion Picture Experts Group
5. CD – compact disc

Many advantages were found for the Adobe PDF from a user perspective. The text and pictures displayed quickly and clearly. The Acrobat Reader was developed as a document viewer, and had many features to support the user. The Acrobat Reader had separate functions for navigating within a document and for navigating between documents via hyperlinks (an extremely desirable feature). Document navigation could be achieved through mouse clicks, the Home, End, PageUp and PageDown keys, and the arrow keys. The user could find his/her way through the document by means of bookmarks (like a table of contents) or thumbnails (tiny pictures of each page). Both of these methods had their own special advantages. The PDF viewer permitted pages to be viewed in almost any size from thumbnails up to 800X magnifications. The mouse could be used to slide the image around the display screen to locate and display areas of interest. These multiple document viewing capabilities satisfied the project objective of zoom-in capability to areas of special interest. The Acrobat Reader permitted text to be searched for specific words or topics. Selected pages or the entire PDF document could be printed. The text document display and printed format did not vary depending upon the printer or printer settings of the user's computer. **Adobe PDF should be considered for electronic publishing of text files because the Acrobat viewer facilitated navigation through the document and retained the original format for viewing as well as printing. (R3)** Text could be copied and inserted into other applications, however formatting was lost when copying from PDF files and pasting into Microsoft Word documents. **Portions of documents expected to be copied and pasted into other documents should be included in the CD-ROM in Microsoft Word to ensure format retention. (LL24)**

Multimedia Fusion was tested and was found to be a powerful, capable, and bug-free program that produced a self-running product that ran on all computers tested which had a suitable MPEG movie viewer. There were several cases where the user's computer was not configured to support display of the MPEG movies, but MPEG movie support was a stated user system requirement. **The use of self-running multimedia files should be used because self-running files did not require installation on the user's computer, and multimedia display was not dependent upon the specific browser or browser settings on the user's computer. (R4)**

CONCLUSIONS AND RECOMMENDATIONS

The overall objective of demonstrating the application and worth of multimedia methods and electronic publication for testing and reporting was attained. The developed technical report (TR) was published on compact disc-read-only memory (CD-ROM) in a format that was acceptable to the Defense Technical Information Center (DTIC) for electronic publishing. The multimedia TR was well received by the user.

2. Electronic publishing on CD-ROM, including interactive multimedia, should be considered for future Air Force Flight Test Center technical publications. (Page 15)

The project objective of using multimedia for data collection and analysis was not achieved because of inadequate test data. The inadequate data collected during the night vision system (NVS) test resulted from the fact that data collection requirements for Edwards Stores Separation and Analysis System (ESSAS) application were not specified during the test-planning phase.

1. Multimedia should be considered during the initial test-planning phase to ensure success with data collection, data analysis, and results publication. (Page 5)

The use of Adobe portable document format (PDF) files with the Acrobat reader for viewing text documents was demonstrated as a good choice, producing an excellent and user-friendly publication product acceptable to DTIC. The PDF was designed for electronic document publication and computer viewing rather than for word processing. Altogether, the Acrobat reader provided rapid and satisfying methods for navigating text documents and accessing the multimedia presentation when published on computer media (CD-ROM).

3. Adobe PDF should be considered for electronic publishing of text files because the Acrobat viewer facilitated navigation through the document and retained the original format for viewing as well as printing. (Page 16)

Multimedia Fusion was used as the multimedia-authoring program, and the product was developed as a self-running executable file.

4. The use of self-running multimedia files should be used because self-running files did not require installation on the user's computer, and multimedia display was not dependent upon the specific browser or browser settings on the user's computer. (Page 16)

REFERENCES

1. *Evaluation of the AN/AVS-8 Night Vision System*, AFFTC-TERS-97-17, Air Force Flight Test Center, Edwards Air Force Base, California, January 1998.

2. *Writing AFFTC Technical Reports*, AFFTC-TIH-97-01, Air Force Flight Test Center, Edwards Air Force Base, California, October 1997.

3. Badre, Albert, and Shneiderman, Ben, *Directions in Human/Computer Interaction*, Ablex Publishing Corporation, Norwood, New Jersey, 1982.

4. Sullivan, Joseph W. and Tyler, Sherman W., Eds., *Intelligent User Interfaces* Addison-Wesley Publishing Co., New York, New York, 1991.

5. Ravden, Susannah J. and Johnson, Graham I, *Evaluating Usability of Human-Computer Interfaces: A Practical Method*, Ellis Horwood Limited, a division of John Wiley and Sons, New York, 1989.

6. Barrett, Edward, Ed., *Text, ConText, and HyperText: Writing with and for the Computer*, The MIT Press, Cambridge, Massachusetts, 1988.

7. Davis, Jack, and Merritt, Susan, *The Web Design Wow! Book,* Peachpit Press, Berkeley, California, 1998.

8. Thacker, William, *Requirements for Successful ESSAS Data Analyses*, Edwards Stores Separation Analysis Group, Edwards AFB, California, July 1988.

9. Thacker, William, *Night Vision Goggles Data Analysis Report*, Edwards Stores Separation Analysis Group, Edwards AFB, California, July 1998.

10. *DTIC Contributors' Handbook*, Defense Technical Information Center, April 1998. http://www.dtic.mil/dtic/contribguide/

11. *IMSI Multimedia Fusion Reference Manual*, IMSI Corporation, San Raefel, California, 1988.

12. *The HTML Writers Guild.*, HTML Resources: Validation. http://www.hwg.org/resources/html/validation.html

13. *W3C's HTML Home Page*, http://www.W3.org/MarkUp/Overview.html

14. Koch, Stefan, *Voodoo's Introduction to JavaScript*, Version 2.4, 1997, http://www.dpunkt.de/javascript/

15. Nasal, Timothy P. and Ames, Lawrence L., *Evaluation of the AN/AVS-8 Night Vision System*, Air Force Flight Test Center, Edwards Air Force Base, California, AFFTC-TR-97-49, April 1999.

APPENDIX A

REQUIREMENTS FOR EDWARDS STORE SEPARATION ANALYSIS SYSTEM DATA ANALYSIS

REQUIREMENTS FOR EDWARDS STORE SEPARATION ANALYSIS SYSTEM DATA ANALYSIS

(Derived from Reference 8)

Careful planning and data collection system calibration must be performed to ensure success of subsequent Edwards Store Separation Analysis System (ESSAS) analyses. With proper input data, ESSAS results may achieve an accuracy of 2 degrees of attitude and 2 inches of movement throughout the entire trajectory of the object. The Range may be tasked to perform the required calibrations. The following planning and system calibrations are required:

1. The exact location of the center of the film plane for each camera must be documented in aircraft coordinates. Location documentation should include a waterline, buttline, and fuselage station locations in conjunction with the pointing angle of the camera. Pointing angles are given in roll, pitch, and yaw as measured in an aircraft type coordinate system.

2. The camera/lens system must be calibrated. The camera/lens calibration consists of mounting the camera/lens onto a fixture and then shooting film of the fixture. The film of the fixture then permits calculation of the depth-of-field of the lens as well as the determination of an 'inches to raster counts' conversion factor. The inches to raster counts conversion allow the Range to match an image size on film accurately to its physical size. The Range has a camera fixture that provides all needed characteristics for this calibration.

3. A calibration is needed of the location of each object to be analyzed in the same aircraft coordinate system as measured for the camera locations. It is necessary to know where the cameras and the objects are in the same reference frame before any movement takes place.

4. All still and motion picture film used in the analyses must be coded with Inter-Range Instrumentation Group (IRIG) time.

APPENDIX B

LESSONS LEARNED SUMMARY

LESSONS LEARNED SUMMARY

LL1. If ESSAS analysis is planned, ESSAS requirements should be considered during the test-planning phase. (Page 5)

LL2. The up-graded ESSAS capability should be considered as a resource to support multimedia data collection, film digitization, and data analysis. (Page 5)

LL3. No single approach considered for text and multimedia authoring met all requirements, and compromises were inherent in each approach selected. (Page 8)

LL4. Low-resolution picture files should be used within documents to provide rapid display, and high-resolution copies of these pictures provided on the CD-ROM for printing, high quality display, or other uses. (Page 8)

LL5. Blank pages should not be incorporated into electronic publications because they are annoying for the reader. (Page 8)

LL6. Single column format should be used for electronic publications because dual column format required twice as much mouse or keyboard scrolling, which was annoying for the reader. (Page 8)

LL7. Almost all text editing (except for inserting or revising hyperlinks) should be done in the Microsoft Word files before conversion into PDF files. (Page 8)

LL8. Adobe Acrobat Version 4.0 or later should be used for creating PDF files from document files. (Page 9)

LL9. Hyperlinks should be established in the Adobe PDF files as they are configured for publication to reduce redundancy of verification efforts. (Page 9)

LL10. Hyperlinks should take the reader to the exact position desired within a document, rather than to the start of a file. (Page 9)

LL11. Trial CDs should be recorded and tested on different computers to ensure that hyperlinks were not made to unintended files residing in other locations on the authoring computer. (Page 9)

LL12. As a prerequisite for successful electronic publication, all user computers should be configured to support multimedia. (Page 9)

LL13. Individual computer set-ups were found to vary considerably in terms of browser selection, browser plug-ins, video cards, and display settings, all of which affected performance. (Page 9)

LL14. The Base needs to have the capability to digitize 16-mm movie film on a frame by frame basis and to convert these images into high-resolution movie files. (Page 12)

LL15. Monophonic sound recordings were found to be satisfactory for narration. (Page 12)

LL16. All software needed for display of the multimedia presentation, including DLL files, should be included on the published CD-ROM. (Page 12)

LL17. Verification testing, often called 'beta testing', should be performed on all multimedia products intended for publication. (Page 13)

LL18. An HTML validation test should be performed on all HTML documents that are intended for publication. (Page 13)

LL19. The latest versions of all software considered for use should be evaluated for meaningful performance improvements. (Page 13)

LL20. High quality blank CD-ROM media should be selected to ensure media longevity as well as for playback compatibility with different CD-drives and computer systems. (Page 14)

LL21. A 'ReadMe.txt' file on the CD-ROM should specify user requirements for computer hardware and software. (Page 14)

LL22. Archival quality CD-ROM labels should be used to hold up under years of expected usage. (Page 14)

LL23. The published CD label should be included on the CD-ROM in printable format, such as Adobe PDF, to support disc copy for duplication or replacement. (Page 14)

LL24. Portions of documents expected to be copied and pasted into other documents should be included in the CD-ROM in Microsoft Word to ensure format retention. (Page 16)

APPENDIX C

HARDWARE AND SOFTWARE USED

HARDWARE AND SOFTWARE USED

1. Adaptec Easy CD Creator Standard Edition Version 3.5, Adaptec, Inc., 691 S Milpitas Blvd., Milpitas, CA 95035. http://www.adaptec.com/

2. Adobe PhotoShop 4.0 LE, Acrobat PDF Writer, Acrobat Distiller, and Acrobat Exchange Version 3.01. Adobe Systems, Inc. 345 Park Ave., San Jose, CA, 95110-2704. http://www.adobe.com/

3. Astound Version 5.0, Astound Incorporated, 5155 Spectrum Wy., Unit 5, Mississauga, Ontario, Canada L4W5A1. http://www.astound.com/frames/astound.html

4. Corel PhotoPaint 7, Corel Corporation, 1600 Carling Ave., Ottawa, Ontario, Canada K1Z8R7. http://www.corel.com/

5. CSE 3310 HTML Validator. http://htmvalidator.com/

6. Dell OptiPlex GX1 computer with 400 MHz Pentium II processor with 128 MB SDRAM, 32X CD-ROM reader, ultra wide SCSI controller, 8 MB AGP video card, and equipped for multimedia presentation. http://www.dell.com/

7. Diamond Multimedia Sonic Impact S90. Diamond Multimedia Systems, 2880 Junction Ave., San Jose, CA 95134-1992. http://www.diamond.com/

8. Labtec C-324 noise-canceling headset with boom microphone. http://www.labtec.com/

9. IMSI Multimedia Fusion Version 1.0, IMSI Corporation, 75 Rowland Wy., Novato, CA 94945. http://www.imisoft.com/mmfusion/index.html; http://clickteam.com/

10. Macromedia Director 6.5, Macromedia Products. http://www.macromedia.com/

11. Microtek ScanMaker 5 flatbed scanner, Microtek Lab, Inc., 3715 Doolittle Dr., Redondo Beach, CA 90278-1226. http://www.microtek.com/

12. Opera Web Browser Version 3.5. http://www.opera.com/

13. Serif DrawPlus 4 software, Serif SPC, P.O. Box 803, Nashua, NH 03061. http://www.serif.com/

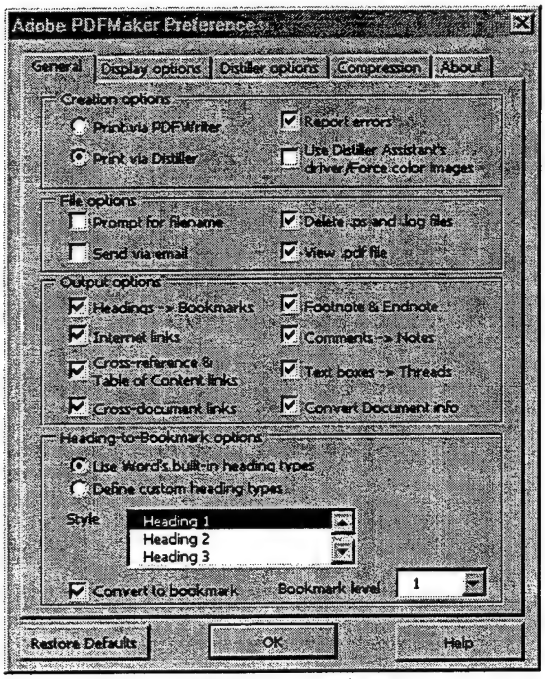
14. Smart and Friendly SCSI CD-ROM recorder, Model CD-R 4012, Smart and Friendly, Inc., P.O. Box 2312, Chatsworth, CA 91313-2312. http://www.smartandfriendly.com/

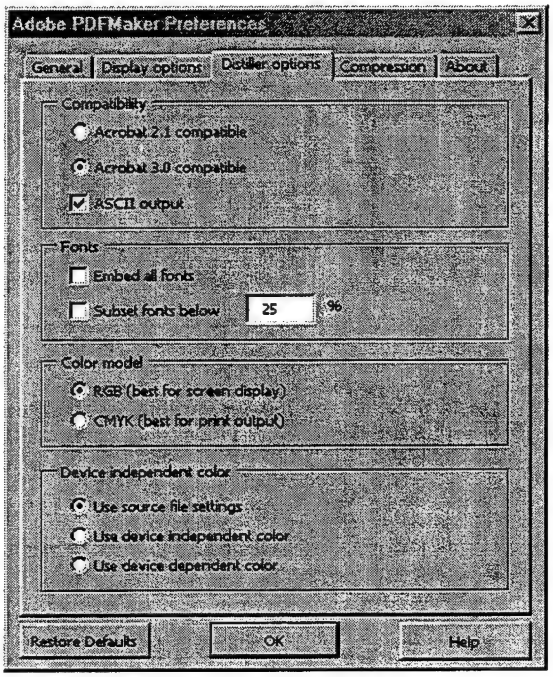
15. SNAZZI Video Capture Card with supporting software Version 2.12. Dazzle Multimedia Corporation, 45778 Northport Loop W., Fremont, CA 94538.

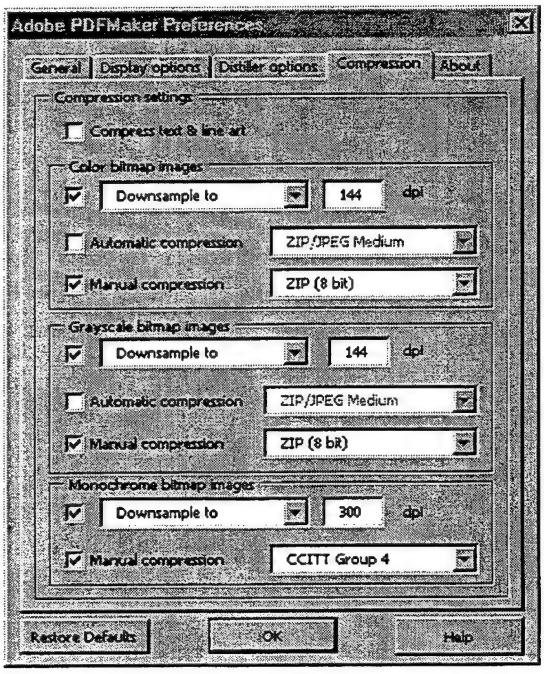
APPENDIX D

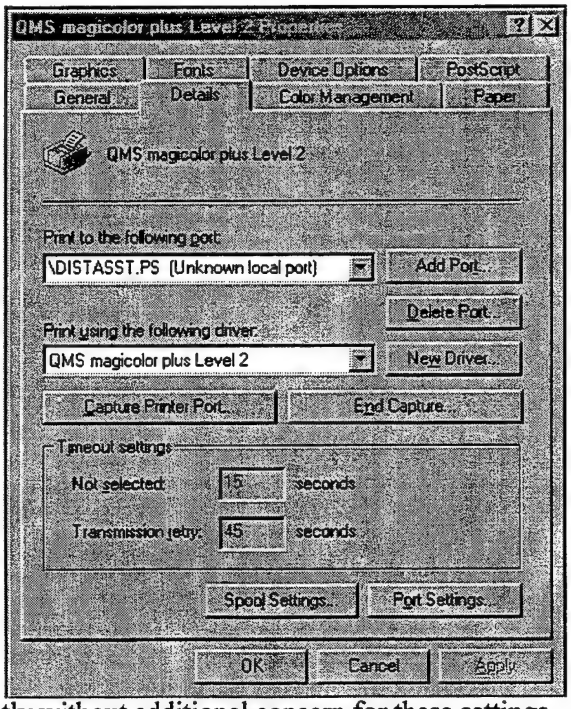
ADOBE ACROBAT VERSION 3.01 SETTINGS USED

ADOBE ACROBAT VERSION 3.01 SETTINGS USED









NOTE: Adobe Acrobat Version 4.0 installed correctly without additional concern for these settings.

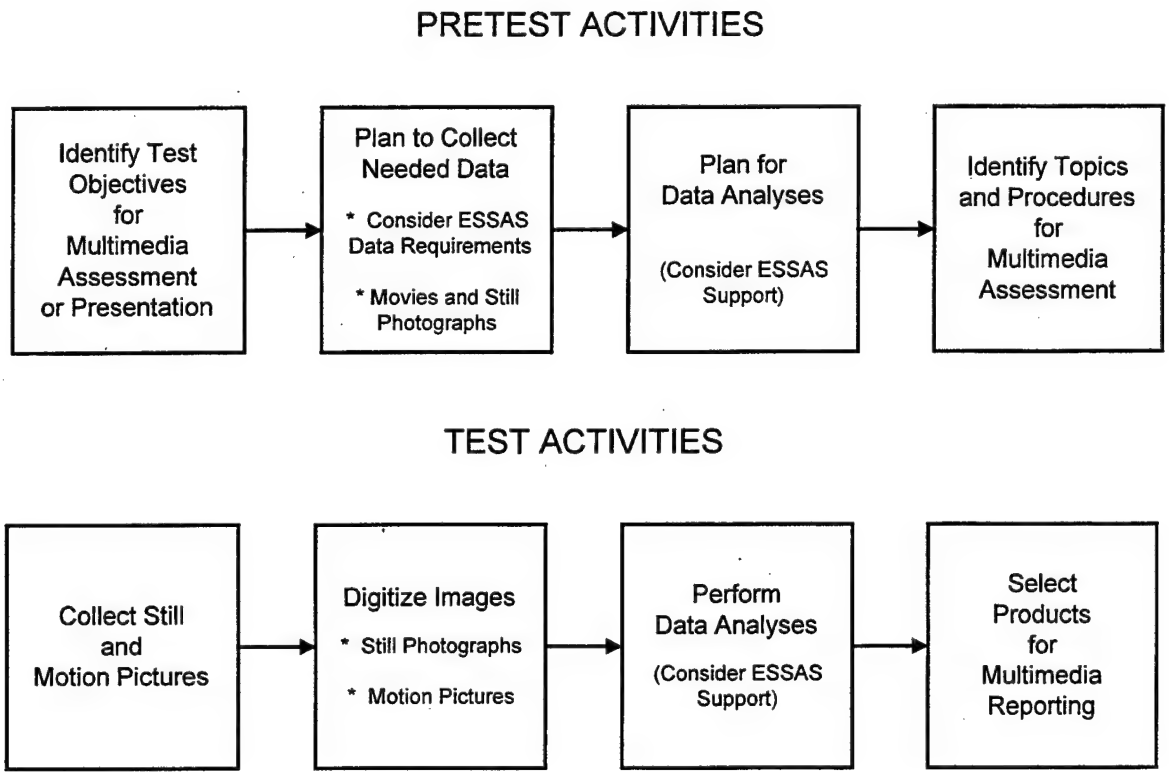
APPENDIX E

GENERIC MULTIMEDIA PUBLICATION GUIDANCE

GENERIC MULTIMEDIA PUBLICATION GUIDANCE

PRETEST AND TEST ACTIVITIES

Figure E1 provides generic guidance for future multimedia publishing efforts. Successful multimedia efforts should start during the initial test-planning phase. Test objectives for multimedia analysis or reporting should be identified, data collection requirements should be specified, analytic methods using multimedia should be identified, and methods for displaying test results developed. Coordination with the Edwards Stores Separation and Analysis System (ESSAS) group should be accomplished if appropriate. Requirements for still pictures, movie pictures, and sound recordings should be identified, using Appendix A for guidance. During testing, all required photographs, movies, and audio recording should be obtained and these products should be time coded with Inter-Range Instrumentation Group time. The ESSAS group may provide support for 16-mm movie film digitization, data analysis, and plotting of test results. Still photographs and sound recordings may be digitized in-house or through contractor support.

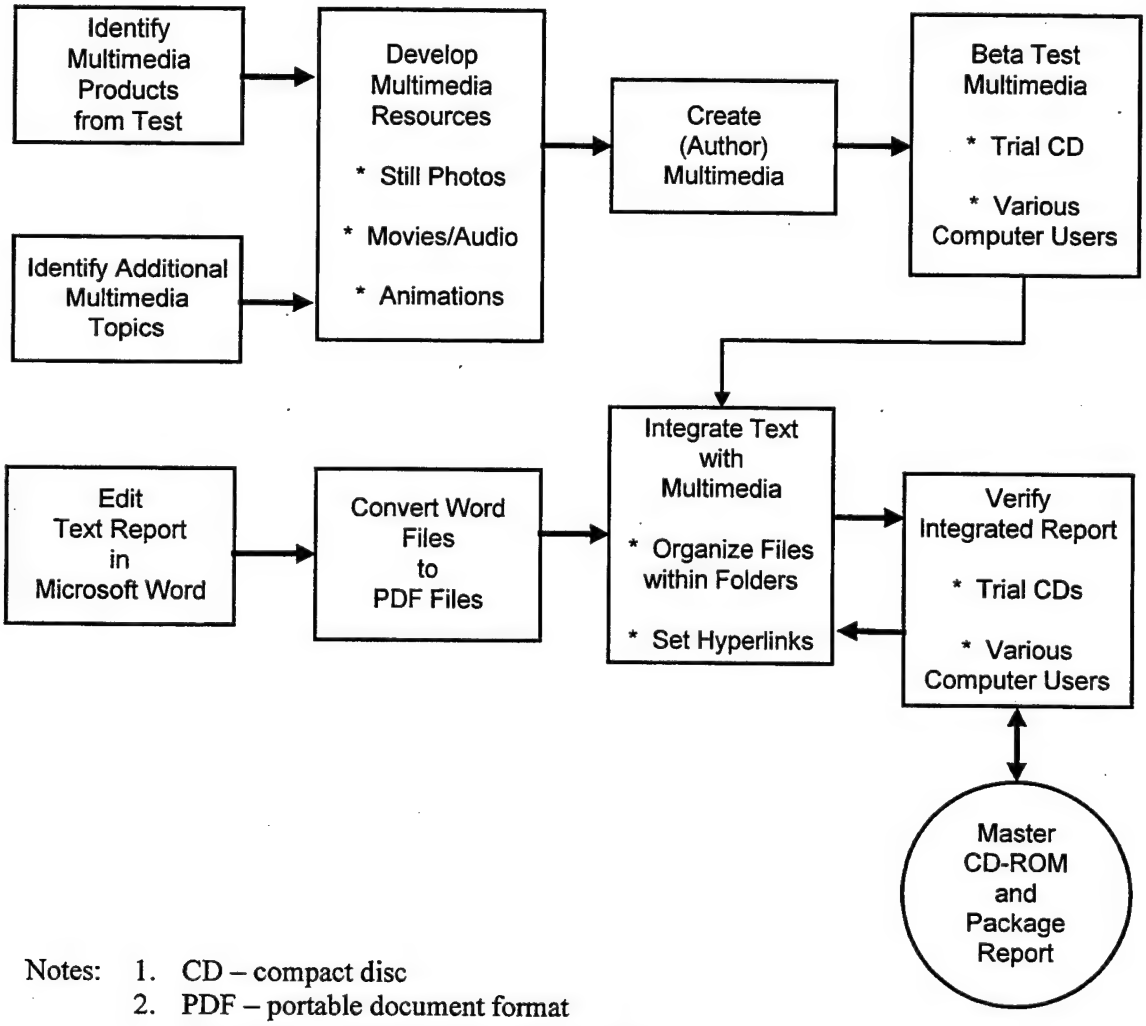


Note: 1. ESSAS – Edwards Stores Separation and Analysis System

Figure E1 Generic Pretest and Test Activities

DEVELOPING MULTIMEDIA REPORTS

Figure E2 provides generic guidance for developing multimedia reports. Normally, the text report would be developed in Microsoft Word and converted to Adobe portable document format (PDF) files. Text reports could then be supported with separate multimedia presentations that would be associated through hyperlinks. This approach would continue the traditional look and structure of Air Force Flight Test Center (AFFTC) paper-based reports while at the same time introducing the newer technologies of electronic publication, hyperlinks, and interactive multimedia. The combination of text report and multimedia would then be recorded on compact disc-read-only memory (CD-ROM) for publication and distribution. Because of the newness of electronic publishing, some conventional paper-based reports may still be necessary.



Notes:
1. CD – compact disc
2. PDF – portable document format
3. CD-ROM – compact disc-read-only memory

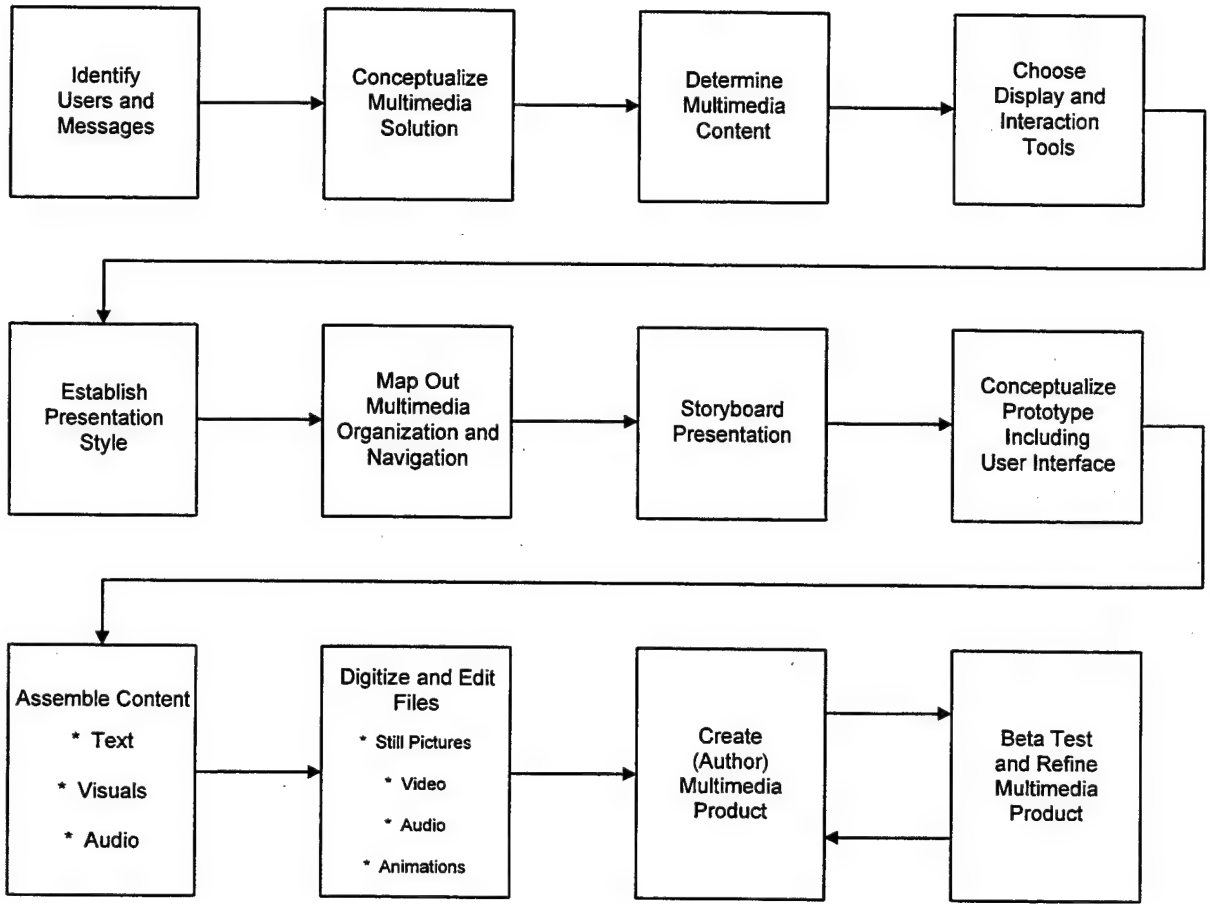
Figure E2 Generic Plan for Developing Multimedia Reports

Figure E2 also illustrates that multimedia products produced during data analysis could be included in the final report. On the other hand, new multimedia topics may be identified and developed for reporting. The media products required for multimedia presentation should be identified and catalogued. Detailed multimedia authoring procedures are discussed below. The multimedia frames should be verified as they are developed. When the multimedia is completed, the product should be recorded on CD-ROM and checked on a variety of computers and with a variety of users.

Technical reports are typically developed in Microsoft Word. During the example publication effort, the PDF was found to be superior to Word for electronic publishing as well as being acceptable to DTIC. All document editing should be done in Word, using the default PostScript driver used for the PDF driver, as only minor changes may be performed on the resultant PDF files. That is, hyperlinks can be set and single words or an existing line could be deleted or modified in minor ways. However, major editing cannot be done. Words cannot be added where none existed before, line height or spacing cannot be changed, and word wrap or paragraph formatting cannot be accomplished. A parallel copy of the report may have to be developed for the paper-based publication that has the required blank pages and other minor differences. All the report files intended for electronic publishing should be assembled on the computer to be used for recording in the exact folders and configuration intended for publication. All document links should be set and verified within this publication-ready configuration, and the hard drive should be defragmented prior to recording. A point to consider during multimedia verification is that hyperlinks could be set unintentionally to files elsewhere on the authoring computer, and that verification of links using different computers is essential for detecting these false links. Recording may be accomplished using Adaptec EZ CD Creator for the first copy. High quality CD media should be considered to support compatibility and longevity. Blank CD media vary considerably in terms of physical construction, chemistry, and recording and playback compatibility. The 'copy CD' function may then be used to make additional CDs. The completed discs should be labeled and packaged for publication. Archival quality CD labels and label printing should be used, and files for printing duplicate labels should be included on the CD, preferably in Adobe PDF format.

STEPS FOR MULTIMEDIA AUTHORING

Figure E3 presents detailed steps for multimedia authoring, which have been modified from Reference 7. This reference book provides many excellent examples of multimedia projects, including conceptual approaches, frame layouts, presentation styles, GUIs, the hardware and software used for development, the multimedia development team, and the amount of time required for development. Since every project is different, no exact procedure can be developed. However, the steps identified provide insight into the overall multimedia authoring process as well as identifying areas for concern.



NOTE: Modified from Reference 7, Web Design Wow! Book.

Figure E3 Detailed Steps for Multimedia Authoring

Identify Users and Messages:

The first step for multimedia authoring is to identify the users and the messages that are to be communicated. Technical reports have many potential users, such as high-level decision-makers, program managers, contractors, military personnel in the field, and AFFTC test engineers. General types of information to be communicated with technical reports include test objectives, test methods, test results, test conclusions, system deficiencies, and recommendations for system improvement. Specific messages or topics should be identified where multimedia presentations may be used to maximum advantage.

Conceptualize Multimedia Solution:

Identification of the messages to be communicated establishes goals for multimedia development. Other factors to consider are the look and feel of the presentation, the size of the presentation, and whether the presentation should provide links to outside sources via the WWW. A home page (or leadoff menu page) should be developed to tell the user at a glance what types of information are included in the presentation and the methods (i.e., navigational tools) for accessing this information.

Determine Multimedia Content:

Knowledge of the messages to be communicated and understanding of the potential users should help the author to identify specific media and combinations of media for the presentation. Data analyses performed during the test may have produced movies, sound tracts, and still pictures that may be employed in the multimedia publication. Some multimedia content may have to be developed specifically for the report. The type and extent of user interaction should be considered.

Choose Display Interaction Tools:

Interactivity is an important new capability for electronic publication. Interactivity should be used to the fullest extent to support active user involvement, accessing information, understanding presentation messages, and permitting users to make a unique path through the document. Multimedia presentations may include sound, motion, graphics, animation, user interaction, and hyperlinks. Other multimedia technologies may be considered for technical publication, and these features include text that moves across the screen, charts that grow over time, and elegant transitions from one frame to the next. The display and interaction tools selected for technical reporting should make the informational content more accessible, more understandable, more enjoyable, and better remembered.

Establish Presentation Style:

Multimedia presentations should be an appealing and rewarding experience for the user. The style and 'personality' of the multimedia should reflect the character of the sponsoring agency, support the messages to be communicated, and make the presentation both effective and enjoyable. The presentation should have a degree of consistency from one frame to the next, reflecting unity of design. For technical reporting, the presentation should be dignified and professional, yet engage the user's attention, interest, and desire for in-depth study.

Map-out Organization and Navigation:

Presentations should be mapped-out graphically, so that the entirety of the presentation can be seen at a glance. Figure 3 is the flowchart used for the multimedia technical report described within this document. This test case presentation contained 81 frames, although size should not be a primary consideration. This flowchart describes the logical structure of the presentation and the logical relationship between frames. The procedure for navigation should be obvious and straightforward. In general, a presentation should contain a 'home page', which presents the scope of the presentation and navigational tools for accessing the major topic areas. In general, the number of navigation options for each page should be limited to about 10, and all information should be accessible within three levels of depth. The multimedia author's concept of the path to be used for accessing information should be clear to the user, but at the same time the user should be able to determine a unique path to be taken. That is, the user should be permitted to feel in control of the multimedia experience.

Storyboard Presentation:

Storyboarding is an excellent method for defining the specific frames (pages) of the presentation. Objectives of storyboarding are to ensure that the content is complete and that all the planned paths through the frames are logical and complete. The presentation should start with a 'home page' that identifies the overall topic of the presentation, provides hyperlink access to all

the major topics, and which provides a point to which the user can always return. There should not be any dead-end paths. One method for storyboarding would be to describe each frame (page) on a sticky note, and to structure these sticky notes on a white board or tabletop. The ease of repositioning and changing sticky notes is a major advantage of this approach. The sticky notes could be repositioned, modified, added to, or deleted. The multimedia author and other reviewers could evaluate different possible paths through the material and determine the most desirable structure for the material.

Conceptualize Prototype Including User Interface:

Each frame identified during storyboarding may be elaborated in full size in the aspect ratio for publication. For example, the display format for the test case multimedia was 800 X 600 pixels, having an aspect ratio of 4:3. One approach would be to establish a generic layout grid in template format that could accommodate the proposed informational content as well as the proposed GUI. Several templates could be developed to accommodate different types of information, such as motion pictures, text, and charts. Templates would be desirable to provide a sense of design unity as well as saving authoring work. That is, templates could be developed only once, and these templates could be used in numerous frames to provide many common features such as background images, logos, icons, push buttons, and mock data fields. Unused navigational controls on specific pages could be grayed out to indicate that they were non-operational, thus keeping the positions of the controls the same on each multimedia page. Templates may be altered as desired to meet special needs. Each prototype page should be refined to show final layouts, including text boxes, illustrations, tables, charts, movies, and animations. The layouts should identify picture and movie fields in terms of size in pixels. Timelines and transitions from one frame to the next may also be identified. The prototype frames may be subjected to critical review and revision during the prototype stage, as the prototyping phase is the time to make changes and to ensure that everything is in order. Prototype multimedia presentations are a major creative project associated with multimedia development, and should be done to a level of detail that multimedia specialists could take this information in conjunction with required text, visuals, and other source files and develop the desired multimedia presentation.

Assemble Content:

The source files for all the multimedia content to be employed should be assembled and cataloged. Content may include text, visuals, and audio. Additionally, standards may be established for the look and feel of the presentation. Colors, typefaces, icons, figure labeling, and display and navigation features of the presentation could be defined. The AFFTC author's instruction (Reference 2) identifies standards for printed reports, but this document is not currently applicable to multimedia. In the future, official AFFTC publication standards could be developed for multimedia publications that include template files.

Digitize and Edit Files:

Multimedia source documents must be digitized for computer application. Still photographs could be scanned with a scanner and turned into uncompressed high-resolution files, such as Windows bitmap (BMP) or tagged image file format (TIF) files. Initial photo editing should be performed on uncompressed, high-resolution picture files. Edited high-resolution picture files then may be rescaled, compressed, and optimized for computer display. Picture file formats often used for computer display include Joint Photographic Experts Group (JPG) files and Graphics Interchange Format (GIF) files. Motion picture film may be digitized by the ESSAS group and

data analyses and data plots developed as well. High quality computer sound cards have the hardware and software needed for digitizing analog audio sources and for performing editing operations. The sound files may be either monophonic or stereophonic, and the digital files may be in saved as .wav (sound file format) files. All files for multimedia development should be archived so that they will not be lost or over-written.

Create Multimedia Product:

The actual electronic multimedia product is developed with a multimedia-authoring program. The authoring program used for the test case technical report was IMSI Multimedia Fusion. A program called Astound was also tried, but at that time there were unresolved problems with this product. The Astound program deserves a second look, as the observed problems may be corrected in subsequent versions. However, there are many alternative authoring programs that would be capable of producing the required multimedia products. Program development is done frame (or page) at a time. Each multimedia frame may be filled with background colors or images, text blocks, movies, still pictures, animations, sounds, interactivity, navigational tools, and hyperlinks. The internal functionality of each frame may be checked as it is developed, and groups of frames may be assessed together leading up to assessment of the overall product. The output of most multimedia authoring programs may be saved in a variety of formats, but the test case project found that self-running files (EXE) were the most desirable choice.

Beta Test and Refine Multimedia Product:

The multimedia product should be recorded on CD-ROM and tested with different users and different computers. The process of testing software systems for readiness for release is called 'beta testing'. Guidance for beta testing is provided in Appendix F. Many aspects of the presentation should be assessed, including the description of system requirements, operating instructions, the mechanics of operation including navigational controls and links, the overall impression of the multimedia, and the ability of the multimedia to meet its objective for communicating technical information. The processes of testing and revising should continue until the product is ready for publication.

APPENDIX F

BETA TESTING SURVEY

BETA TESTING SURVEY

The purpose of beta testing a product is to determine how the program works on different computers and with a wide variety of users. You are encouraged to try all possible modes of operation and to try to 'break the program' by anticipating how it may be misused. Document all identified problems and concerns on this worksheet.

Title of CD-ROM		Version
Tester Name:		Phone
Operating System	CPU Speed	RAM
CD-ROM Speed	Video Card	Monitor Size

BUG REPORT						
	Broken Link	Broken Video	Broken Sound	Broken Graphic	Broken Chart	Dead-end Path
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Slide #						
Other						
Other						
Other						
Other						
Other						
Other						

Rate test product, circling desired rating.

	Very Unsatisfactory	Unsatisfactory	Marginally Unsatisfactory	Marginally Satisfactory	Satisfactory	Very Satisfactory
1. Computer requirements clearly stated	1	2	3	4	5	6
2. Disc title descriptive of actual contents	1	2	3	4	5	6
3. Running of program on my computer	1	2	3	4	5	6
4. Intuitiveness of navigational tools	1	2	3	4	5	6
5. Capability of navigational tools	1	2	3	4	5	6
6. Simplicity of navigation through document	1	2	3	4	5	6
7. Freedom from culls or dead-end paths	1	2	3	4	5	6
8. Accessibility of information	1	2	3	4	5	6
9. Appropriate use of visual displays	1	2	3	4	5	6
10. Visual display speed on computer	1	2	3	4	5	6
11. Movie/animation quality	1	2	3	4	5	6
12. Quality of audio sounds and narration	1	2	3	4	5	6
13. Appropriate use of sounds/audio	1	2	3	4	5	6
14. Learning supported through audio	1	2	3	4	5	6
15. Appropriate use of narration	1	2	3	4	5	6
16. Appropriate amount of interactivity	1	2	3	4	5	6
17. Content supported by interactivity	1	2	3	4	5	6
18. Learning supported through interactivity	1	2	3	4	5	6
19. Interaction used to increase involvement	1	2	3	4	5	6
20. Ample opportunity to set own path	1	2	3	4	5	6
21. Presentation scope defined on home page	1	2	3	4	5	6
22. Appropriate total amount of information	1	2	3	4	5	6
23. Appropriate presentation sequences	1	2	3	4	5	6
24. Presentations at appropriate level of detail	1	2	3	4	5	6
25. Appropriate presentation style	1	2	3	4	5	6
26. Content supported by movies/animation	1	2	3	4	5	6
27. Interest augmented by movies/animations	1	2	3	4	5	6
28. Interest sustained throughout presentation	1	2	3	4	5	6
29. Quality of product integration	1	2	3	4	5	6
30. OVERALL PRODUCT ASSESSMENT	1	2	3	4	5	6

Likes	Dislikes

Return to: _____ E-Mail: _____ Phone: _____

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition	Units
BMP	bitmap	---
CD	compact disc	---
CD-RW	compact disc-rewritable	---
CD-ROM	compact disc-read-only memory	---
DLL	dynamic link library	---
DTIC	Defense Technical Information Center	---
DVD	digital versatile disc	---
ESSAS	Edwards Stores Separation Analysis System	---
EXE	executable program file	---
GIF	graphics interchange format	---
GUI	graphic user interface	---
HTML	hypertext markup language	---
IRIG	Inter-Range Instrumentation Group	---
JPG	Joint Photographic Experts Group	---
JON	job order number	---
LAN	local area network	---
MB	megabyte	---
MPEG	Motion Picture Experts Group	---
NVS	night vision system	---
PDF	portable document format	---
QDC	quick disconnect	---
RAM	random access memory	---
RTF	rich text format	---
SCSI	small computer system interface	---

LIST OF ABBREVIATIONS AND ACRONYMS (Concluded)

Abbreviation	Definition	Units
SGML	standard generalized markup language	---
SPO	System Program Office	---
TERS	test and evaluation results sheet	---
Test PAES	test planning, analysis, and evaluation system	---
TIF	tagged image file format	---
TR	technical report	---
TSPI	time-space positioning information	---
VHS	video home system	---
.wav	wave sound file format	---
WWW	world wide web	---
X	times (i.e., multiplication)	---